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AUTHOR Katayama, Andrew D.; And Others
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ABSTRACT

Three experiments were conducted to investigate whether graphic organizers (GOs) were more effective than concept maps (CMs) in facilitating text learning. Experiment 1, which involved 56 undergraduates, was a replication of the second experiment of D. H. Robinson and K. A. Kiewra (1995) except that only GO and CM conditions were included. All materials were constructed by outside sources to help avoid researcher bias. Experiment 2, with 46 undergraduates, used a different text and separate GO, CM, and test constructors. Experiment 3 replicated Experiment 2 except that the GO constructor constructed the tests. Results show that GOs only facilitated text learning when they were constructed by the person who also constructed the tests. The implications of this study are that adjunct displays will probably not be useful for classroom learning unless the tests match the types of learning the displays are intended to facilitate. (Contains 15 references.) (Author/SLD)

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Abstract

Which Adjunct Displays Help Students learn Best? A Comparison of the Effectiveness of Researcher-Constructed Displays

Andrew D. Katayama and Daniel H. Robinson - Mississippi State University

Bonnie B. Armbruster - University of Illinois

Nelson F. Dubois - SUNY Oneonta

Judith G. Groulx - Texas Christian University

David H. Jonassen - Pennsylvania State University

Kenneth A. Kiewra - University of Nebraska-Lincoln

William D. Winn - University of Washington

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Three experiments were conducted to investigate whether graphic organizers (GO's) were more effective than concept maps (CM's) in facilitating text learning. Experiment 1 was a replication of Robinson and Kiewra's (1995) second experiment except that only GO and CM conditions sere included. Experiment 2 used a different text, and separate GO, CM, and tests constructors to reduce experimenter bias. Experiment 3 replicated Experiment 2 except that the GO constructor constructed the tests. Results showed that GO's only "facilitate" text learning when they are constructed by someone who also constructs the tests. The implications of this study are that adjunct displays will probably not be useful for classroom learning unless the tests match the types of learning the displays are intended to facilitate.

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Running Head: RESEARCHER-CONSTRUCTED DISPLAYS

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Andrew D. Katayama & Daniel H. Robinson
Mississippi State University

Bonnie Armbruster
University of Illinois

Nelson F. Dubois
SUNY Oneonta

Judith G. Groulx
Texas Christian University

David H. Jonassen
Penn State University

Kenneth A. Kiewra
University of Nebraska-Lincoln

William D. Winn
University of Washington

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of the American Educational Research Association
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New York

Correspondence to:
Daniel H. Robinson
P.O. Box 9727
Mississippi State, MS 39762
robinson@ra.msstate.edu

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Introduction

The traditional method of helping students to learn concept relations has been to supplement text material with outlines. Graphic organizers, traditionally known as advance organizers (Ausubel, 1960) use a linear or if preferred, a two-dimensional presentation to convey concept relations (Bransford & Johnson, 1972). The use of graphic organizers to facilitate reading comprehension has been the subject of numerous research investigations. Knowledge of text structure, training in the use of text structure, and the use of graphic organizers in content area reading has been provided by current research practices in education and psychology.

There are different types of Graphic organizers. A matrix (Kiewra, Dubois, Christian, & McShane, 1988) uses rows and columns to represent a concept and corresponding attribute values. Another type of visual-spatial organizer is a concept map, which uses arrows and lines to connect related concepts without the reference attributable values.

Kruley, Sciama, and Glenberg (1994) found that when students attempted to comprehend text that were accompanied with pictures as compared to texts that have no pictures, their performance on a spatial short-term memory task was diminished. In a similar study Katayama, Robinson and Fan (1995) found that concurrent tasks involving the visuo-spatial sketchpad and the phonological loop support the notion that graphic organizers are viewed like a picture.

Many implications are made through the use of graphic organizers, especially in test taking situations. Because many objective tests are circulated through the knowledge of operant concepts, the use of a visual-spatial system for taking lecture notes on these concepts has also been proven to increase test scores (Kiewra & DuBois, 1992).

This study consisted of two experiments similar in the independent variables (e.g., type of study material) but different among the dependent variables (e.g., the actual test over the material). With time

constraints and the use of a questionnaire in the second study, we were able to assess how the students felt about the "reader friendliness" of the test and materials as well as respond to the time factor.

Participants and Design of Experiment 1

Methodology

Fifty-six undergraduate educational psychology students participated in this experiment in exchange for extra-credit in their undergraduate courses. Each student signed a consent form and was randomly assigned to one of three conditions (text only, text with concept map, or text with graphic organizers).

Materials

All materials were constructed by outside sources to help avoid any researcher bias in this experiment. All outside sources agreed to contribute the material for the purposes of both experiments. All materials remained consistent with the text material that was presented in class.

Text. A section of text taken from Applying Educational Psychology (Dembo, 1994) was used. It consisted of approximately 5,500 words (seven pages, single spaced) over the topic of "classroom instruction and evaluation". One version was used for all three groups.

Concept Map. A one page map consisting of about 600 words, 30 arrows (to show relationships and 40 concept nodes (with main ideas, concepts, etc.) was used as supplemental study material for one of the assigned groups. This concept map (Jonassen, 1994) was used with the acknowledgment of Pennsylvania State University.

Graphic organizers. A seven page study supplement consisting of rows and columns was used with the corresponding text. It covered the same material as the text and the concept map. To prevent researcher bias of study aid, the graphic organizers (Kiewra and Dubois, 1995) were used with permission already granted by the creators at the University of Nebraska and the State University of New York respectively

Tests. To assure unbiased instrumentation, the tests have also been constructed by an outside source. The tests were constructed by Armbruster (1995) and measured facts, relations, and application covered in Dembo's segment of text. The tests were derived upon the text alone as no spatial displays were involved. The tests were used with permission already granted by the originator. The test itself consisted of twenty-four questions: six short answer, two multiple choice, two short essay, and sixteen fill-in-the-blank items.

Procedure

Studying took place during two separate class sessions. In the first session, subjects were handed a 9" x 12" coded envelope containing one of the three study materials and a blank piece of paper to make any notes they wish. The subjects were asked to quietly read their study materials completely. This session lasted approximately 45 mins. after which the students turned in their materials inside of their coded envelopes upon being dismissed

Session two took place two days after the first. The students were given their same study material and were allowed ten mins. to review their material before taking the test. When approximately 45 mins had expired, they were asked to place all their materials inside the envelope, write demographic information on the outer tab (e.g., sex, major, GPA), peel off their names from the envelope to ensure anonymity.

Results

The answer key had also been provided by the originator of the test and was used according to the provided guidelines. Four tests were eliminated from the evaluation because of incomplete answer sheets. For evaluation, each treatment condition was grouped separately and graded accordingly. A 3 study material (text vs. concept map vs. graphic organizer) between groups analysis of variance (ANOVA) was conducted on the collected data. The statistical package used to analyze the data was conducted on a Windows 6.1 SPSS program. There was no significant main effect of study supplement for type of spatial

display. The analysis yielded mean scores for text only group, (M = 15.50, SD = 7.17, $p > .05$) which was not statistically different from the graphic organizer group (M =15.06, SD = 15.06, $p > .05$) and only marginally higher than the concept map group (M = 13.75, SD = 5.88, $p > .05$). There was no significant differences between the groups studying the text only and the concept map or for the graphic organizer group and the concept map group.

Conclusion

This experiment did not support the notion of one type of spatial organizer to be superior to another in enabling students to recall information more efficiently. The hypothesis, that students with graphic organizers as study supplements would score significantly higher than those with the study supplement of concept maps and with no visual-spatial organizers at all (text alone) was actually contradicted. A possible explanation for this finding might infer that the test was constructed with some bias toward the textual perception and test relativity. Therefore, a logical rationale would suggest that because the test constructor had access to only the text and not any of the two spatial displays, the test was based exclusively on the text. From what has been researched on the benefits of graphic organizers as adjunct displays to text, suggestions for future studies would want to also investigate the effectiveness of graphic organizers on test construction .

Participants and Design of Experiment 2

Methodology

Experiment 2 was very similar to experiment 1 with the exception of the test materials and the length of testing. The test materials for this experiment were constructed by a different outside expert. Forty-six undergraduate educational psychology students enrolled at Mississippi State University participated in this research project in exchange for extra-credit. The students were randomly assigned to one of three conditions of a 3 x 2 design. Testing took place in a typical university classroom on the campus of Mississippi State University.

Materials

All study materials were the same as experiment 1. All precautions were made to assure subject confidentiality. Again, all precautions were made to prevent researcher bias on any of the testing material.

Text. The same as experiment 1.

Concept map. The same as experiment 1.

Graphic organizers. The same as experiment 1.

Tests. To assure unbiased instrumentation, the tests were constructed by another outside source. This time the tests were constructed by Kiewra (1995). These tests measured factual and conceptual relationships covered in Dembo's segment of text material. The tests were used with permission granted by the originator. The test consisted of forty-three multiple choice and short answer questions: thirty-three factual and ten conceptual. Each question carried a value of one point. There were a total of forty-three possible points on the test. This test contained more items than the test used in experiment 1 but took about 10 less min. to complete.

Questionnaire. A one page questionnaire consisting of 7 multiple choice questions were given to each student. These questions were developed to assess the students prior knowledge of the content, and various questions seeking the students opinion of the study materials such as reader friendliness of the test and materials, level of interest of the material, etc.

Procedure

The same procedures were used as in experiment 1 for both days. The only variation was about ten min. in time.

Day 1. The first session consisted of a 35 min. reading period in which students were asked to quietly read over the material within their respective envelopes. After approximately 35 min., the students were asked to place their materials inside of their coded envelope and turn them into the researcher.

Day 2. The second session took place two days after the first. The students were given the exact same envelope containing their study materials and were allowed ten mins. to review their material. Then the students were given a test that lasted about 25 min. to complete and were instructed to fill out the provided questionnaire consisting of 7 multiple choice items which took approximately five min. to complete. Upon completion, the students were asked to place their materials into their envelopes, peel their coded labels and turn in their envelopes. The answer key had also been provided by the originator of the test and was used according to the provided guidelines.

Results and Discussion

Each treatment condition was grouped separately and graded accordingly. A 3 study condition (text, concept map or graphic organizer) between groups mixed model analysis of variance (ANOVA) was used to analyze the data upon both factual and conceptual test items as the within groups condition. The results yielded a significant difference for the graphic organizer group ($M = 19.53$, $SD = 6.51$, $p < .05$) than both the text only group ($M = 14.75$, $SD = 3.15$, $p > .05$) and the concept map group ($M = 16.40$, $SD = 2.56$) on the factual items. For the conceptual items, the graphic organizer group ($M = 5.93$, $SD = 1.94$, $p < .05$) scored significantly higher than the text only group ($M = 4.00$, $SD = 1.83$) but only marginally higher than the concept map group ($M = 4.80$, $SD = 2.01$, $p > .05$). There was no difference between the text only and the concept map groups. The total scores between the three groups yielded a significant higher scores for the graphic organizer group ($M = 25.47$, $SD = 7.85$, $p < .05$) than the text only group ($M = 18.75$, $SD = 4.19$, $p < .05$) and the concept map group ($M = 21.20$, $SD = 2.93$, $p < .05$). The concept map group scores were marginally higher than the text only scores.

In addition, the researchers added several of the variables derived from the questionnaire into the analysis to see if there may be an effect of those variables upon the test scores. There was no impact of level of effort reported by the students and conceptual items and on the total score of the tests. Although not significant, within the factual questions, the least amount of effort response scored marginally higher

than the reasonable and considerable amount of effort responses. For the interest levels reported by students, there were no differences among the conceptual and total item scores whereas the factual items observed a higher score for responses regarding more interest. For the students report of prior knowledge, the concept and total items observed higher scores toward the greater the greater the students prior knowledge. However, for the factual items, students scored higher when they viewed the information as being totally novel. There was no impact of reader friendliness of the material and test scores.

Conclusion

As we suspected, the type of test that is constructed and by whom the test was constructed would impact the results of the three groups. In experiment 1 we observed that the text only group had a slight advantage in that the test was constructed by an outsider who only had the chapter length text to go by. Even though the results were not significant, they indicated a slight edge toward the text only condition. The same notion holds true in experiment 2 where this time the test was constructed by the same outsider who constructed the graphic organizers. With this method, we predicted that the students in the graphic organizer group would have an advantage and outperform the other groups on the test. And as a result we found this was true. Perhaps the results would suggest that the type of spatial display is of secondary nature to what is perceived to be important by the test constructor based upon their displays. Further research might investigate the same variables and use the constructor of a concept map to generate a test over the overall material. If this suggested study should yield similar results in favor for the concept map group then the hypothesis of test constructor bias on tests would be strengthened. Also, to what degree the differences between groups are might indicate which spatial display is more effective in conveying the information being presented for testing purposes.

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